

Sources of Information

For information about career opportunities in the construction industry, contact:

• Associated Builders and Contractors, 1300 North 17th St., Rosslyn, VA 22209. Internet: <http://www.abc.org>

• Associated General Contractors of America, 1957 E St. NW, Washington, DC 20006-5199. Internet: <http://www.agc.org>

For information about constructor certification and professional career opportunities in the construction industry, contact:

• American Institute of Constructors, 466 94th Ave. North, St. Petersburg, FL 33702. Internet: <http://www.aicnet.org>

For information about construction management and construction manager certification, contact:

• Construction Management Association of America, 7918 Jones Branch Dr., Suite 540, McLean, VA 22102. Internet: <http://www.access.digex.net/~cmaa>

Information on accredited construction science and management programs and accreditation requirements is available from:

• American Council for Construction Education, 1300 Hudson Lane, Suite 3, Monroe, LA 71201-6054. Internet: <http://www.acce.org>

Cost Estimators

(O*NET 21902 and 85305D)

Significant Points

- Growth of the construction industry, where about 58 percent of all cost estimators are employed, will be the driving force behind the demand for these workers.
- Job prospects in construction should be best for those workers with a degree in construction management or construction science, engineering, or architecture, and who have practical experience in various phases of construction or in a specialty craft area.

Nature of the Work

Accurately forecasting the cost of future projects is vital to the survival of any business. Cost estimators develop cost information for owners or managers to use in determining resource and material quantities, making bids for contracts, determining if a new product will be profitable, or determining which products are making a profit for a firm.

Regardless of the industry in which they work, estimators compile and analyze data on all the factors that can influence costs—such as materials, labor, location, and special machinery requirements, including computer hardware and software. Job duties vary widely depending on the type and size of the project. *Costs engineers* usually have an engineering background and apply scientific principles and methods to undertake feasibility studies, value engineering, and life-cycle costing.

The methods of and motivations for estimating costs can vary greatly, depending on the industry. On a construction project, for example, the estimating process begins with the decision to submit a bid. After reviewing various drawings and specifications, the estimator visits the site of the proposed project. The estimator needs to gather information on access to the site and availability of electricity, water, and other services, as well as surface topography and drainage. The information developed during the site visit usually is recorded in a signed report that is made part of the final project estimate.

After the site visit is completed, the estimator determines the quantity of materials and labor the firm will have to furnish. This process, called the quantity survey or “takeoff,” involves completing standard estimating forms, filling in dimensions, number of units, and other information. A cost estimator working for a general contractor, for example, will estimate the costs of all items the contractor must provide. Although subcontractors will estimate their costs as part of their own bidding process, the general contractor’s cost estimator often analyzes

bids made by subcontractors as well. Also during the takeoff process, the estimator must make decisions concerning equipment needs, sequence of operations, and crew size. Allowances for the waste of materials, inclement weather, shipping delays, and other factors that may increase costs must also be incorporated in the estimate.

On completion of the quantity surveys, the estimator prepares a total project cost summary, including the costs of labor, equipment, materials, subcontracts, overhead, taxes, insurance, markup, and any other costs that may affect the project. The chief estimator then prepares the bid proposal for submission to the owner.

Construction cost estimators may also be employed by the project’s architect or owner to estimate costs or track actual costs relative to bid specifications as the project develops. In large construction companies employing more than one estimator, it is common practice for estimators to specialize. For instance, one may estimate only electrical work and another may concentrate on excavation, concrete, and forms.

In manufacturing and other firms, cost estimators usually are assigned to the engineering, cost, or pricing departments. The estimators’ goal in manufacturing is to accurately estimate the costs associated with making products. The job may begin when management requests an estimate of the costs associated with a major redesign of an existing product or the development of a new product or production process. When estimating the cost of developing a new product, for example, the estimator works with engineers, first reviewing blueprints or conceptual drawings to determine the machining operations, tools, gauges, and materials that would be required for the job. The estimator then prepares a parts list and determines whether it is more efficient to produce or to purchase the parts. To do this, the estimator must initiate inquiries for price information from potential suppliers. The next step is to determine the cost of manufacturing each component of the product. Some high technology products require a tremendous amount of computer programming during the design phase. The cost of software development is one of the fastest growing and most difficult activities to estimate. Some cost estimators now specialize in only estimating computer software development and related costs.

The cost estimator then prepares time-phase charts and learning curves. Time-phase charts indicate the time required for tool design and fabrication, tool “debugging”—finding and correcting all problems—manufacturing of parts, assembly, and testing. Learning curves graphically represent the rate at which performance improves with practice. These curves are commonly called “cost reduction” curves because many problems—such as engineering changes, rework, parts shortages, and lack of operator skills—diminish as the number of parts produced increases, resulting in lower unit costs.



Cost estimators compile and analyze data on all factors that can influence costs, including materials, labor, location, and special machinery requirements.

Using all of this information, the estimator then calculates the standard labor hours necessary to produce a predetermined number of units. Standard labor hours are then converted to dollar values, to which are added factors for waste, overhead, and profit to yield the unit cost in dollars. The estimator then compares the cost of purchasing parts with the firm's cost of manufacturing them to determine which is cheaper.

Computers play an integral role in cost estimating today, because estimating may involve complex mathematical calculations and require advanced mathematical techniques. For example, to undertake a parametric analysis, a process used to estimate project costs on a per unit basis subject to the specific requirements of a project, cost estimators use a computer database containing information on costs and conditions of many other similar projects. Although computers cannot be used for the entire estimating process, they can relieve estimators of much of the drudgery associated with routine, repetitive, and time-consuming calculations. Computers are also used to produce all of the necessary documentation with the help of word-processing and spreadsheet software. This leaves estimators with more time to study and analyze projects and can lead to more accurate estimates.

Working Conditions

Although estimators spend most of their time in an office, construction estimators must make visits to project work sites that can be dusty, dirty, and occasionally hazardous environments. Likewise, estimators in manufacturing must spend time on the factory floor where it also can be noisy and dirty. In some industries, frequent travel between a firm's headquarters and its subsidiaries or subcontractors also may be required.

Although estimators normally work a 40-hour week, overtime is common. Cost estimators often work under pressure and stress, especially when facing bid deadlines. Inaccurate estimating can cause a firm to lose out on a bid or lose money on a job that was not accurately estimated.

Employment

Cost estimators held about 152,000 jobs in 1998, about 58 percent of whom were in the construction industry. Another 26 percent of salaried cost estimators were employed in manufacturing industries. The remainder worked for engineering and architectural services firms, business services firms, and throughout a wide range of other industries. Operations research, production control, cost, and price analysts who work for government agencies may also do significant amounts of cost estimating in the course of their regular duties. In addition, the duties of construction managers may also include estimating costs. (For more information, see the statements on operations research analysts and construction managers elsewhere in the *Handbook*.)

Cost estimators work throughout the country, usually in or near major industrial, commercial, and government centers, and in cities and suburban areas undergoing rapid change or development.

Training, Other Qualifications, and Advancement

Entry requirements for cost estimators vary by industry. In the construction industry, employers increasingly prefer individuals with a degree in building construction, construction management, construction science, engineering, or architecture. However, most construction estimators also have considerable construction experience, gained through tenure in the industry, internships, or cooperative education programs. Applicants with a thorough knowledge of construction materials, costs, and procedures in areas ranging from heavy construction to electrical work, plumbing systems, or masonry work have a competitive edge.

In manufacturing industries, employers prefer to hire individuals with a degree in engineering, physical science, operations research, mathematics, or statistics, or in accounting, finance, business, economics, or a related subject. In most industries, great emphasis is placed on experience involving quantitative techniques.

Cost estimators should have an aptitude for mathematics, be able to quickly analyze, compare, and interpret detailed and sometimes poorly defined information, and be able to make sound and accurate judgments based on this knowledge. Assertiveness and self-confidence in presenting and supporting their conclusions are important, as are strong communications and interpersonal skills, because estimators may work as part of a project team alongside managers, owners, engineers, and design professionals. Cost estimators also need knowledge of computers, including word-processing and spreadsheet packages. In some instances, familiarity with special estimation software or programming skills may also be required.

Regardless of their background, estimators receive much training on the job; almost every company has its own way of handling estimates. Working with an experienced estimator, they become familiar with each step in the process. Those with no experience reading construction specifications or blueprints first learn that aspect of the work. They then may accompany an experienced estimator to the construction site or shop floor where they observe the work being done, take measurements, or perform other routine tasks. As they become more knowledgeable, estimators learn how to tabulate quantities and dimensions from drawings and how to select the appropriate material prices.

For most estimators, advancement takes the form of higher pay and prestige. Some move into management positions, such as project manager for a construction firm or manager of the industrial engineering department for a manufacturer. Others may go into business for themselves as consultants, providing estimating services for a fee to government or construction and manufacturing firms.

Many colleges and universities include cost estimating as part of bachelor's and associate degree curriculums in civil engineering, industrial engineering, and construction management or construction engineering technology. In addition, cost estimating is a significant part of many master's degree programs in construction science or construction management. Organizations representing cost estimators, such as American Association of Cost Engineers (AACE) International and the Society of Cost Estimating and Analysis, also sponsor educational and professional development programs. These programs help students, estimators-in-training, and experienced estimators stay abreast of changes affecting the profession. Specialized courses and programs in cost estimating techniques and procedures are also offered by many technical schools, community colleges, and universities.

Voluntary certification can be valuable to cost estimators, because it provides professional recognition of the estimator's competence and experience. In some instances, individual employers may even require professional certification for employment. Both AACE International and the Society of Cost Estimating and Analysis administer certification programs. To become certified, estimators usually must have between 3 and 7 years of estimating experience and must pass both a written and an oral examination. In addition, certification requirements may include publication of at least one article or paper in the field.

Job Outlook

Overall employment of cost estimators is expected to grow about as fast as average for all occupations through the year 2008. No new projects in construction, manufacturing, or other industries are undertaken without careful analysis and estimation of the costs involved. In addition to openings created by growth, some job openings will also arise from the need to replace workers who transfer to other occupations or leave the labor force.

Growth of the construction industry, where about 58 percent of all cost estimators are employed, will be the driving force behind the demand for these workers. The fastest growing sectors of the construction industry are expected to be special trade contractors and those associated with heavy construction and spending on the Nation's infrastructure. Construction and repair of highways and streets, bridges, and construction of more subway systems, airports, water and sewage systems, and electric power plants and transmission

lines will stimulate demand for many more cost estimators. Job prospects in construction should be best for cost estimators with a degree in construction management or construction science, engineering, or architecture, who have practical experience in various phases of construction or in a specialty craft area.

Employment of cost estimators in manufacturing should remain relatively stable as firms continue to use their services to identify and control their operating costs. Experienced estimators with degrees in engineering, science, mathematics, business administration, or economics and who have computer expertise should have the best job prospects in manufacturing.

Earnings

Salaries of cost estimators vary widely by experience, education, size of firm, and industry. Median annual earnings of cost estimators in 1998 were \$40,590. The middle 50 percent earned between \$31,270 and \$53,490. The lowest 10 percent earned less than \$24,330, and the highest 10 percent earned more than \$79,400. Median annual earnings in the industries employing the largest numbers of managers in 1997 were:

Nonresidential building construction	\$43,400
Electrical work	40,800
Plumbing, heating, and air conditioning	40,700
Miscellaneous special trade contractors	39,200
Residential building construction	35,300

College graduates with degrees in fields such as engineering or construction management that provide a strong background in cost estimating could start at a higher level. According to a 1999 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates with degrees in construction science received offers averaging about \$36,600 a year. Bachelor's degree candidates with degrees in construction management received offers averaging \$34,300 a year.

Related Occupations

Other workers who quantitatively analyze information include appraisers, cost accountants, auditors, budget analysts, cost engineers, economists, financial analysts, loan officers, operations research analysts, underwriters, and value engineers. In addition, the duties of production managers and construction managers may also involve analyzing costs.

Sources of Additional Information

Information about career opportunities, certification, educational programs, and cost estimating techniques may be obtained from:

- AACE International, 209 Prairie Ave., Suite 100, Morgantown, WV 26505. Internet: <http://www.aacei.org>
- Professional Construction Estimators Association of America, P.O. Box 11626, Charlotte, NC 28220-1626. Internet: <http://www.pcea.org>
- Society of Cost Estimating and Analysis, 101 S. Whiting St., Suite 201, Alexandria, VA 22304. Internet: <http://www.erols.com/scea>

Education Administrators

(O*NET 15005A and 15005B)

Significant Points

- Most jobs require experience in a related occupation, such as teacher or admissions counselor, and a master's or doctoral degree.
- Many jobs offer high earnings, considerable community prestige, and the satisfaction of working with young people.

- Competition will be keen for jobs in higher education, but opportunities should be better at the elementary and secondary school level.

Nature of the Work

Smooth operation of an educational institution requires competent administrators. Education administrators provide direction, leadership, and day-to-day management of educational activities in schools, colleges and universities, businesses, correctional institutions, museums, and job training and community service organizations. (College presidents and school superintendents are covered in the *Handbook* statement on general managers and top executives.) *Education administrators* set educational standards and goals and establish the policies and procedures to carry them out. They develop academic programs; monitor students' educational progress; train and motivate teachers and other staff; manage guidance and other student services; administer recordkeeping; prepare budgets; handle relations with parents, prospective and current students, employers, and the community; and perform many other duties.

Education administrators also supervise managers, support staff, teachers, counselors, librarians, coaches, and others. In an organization such as a small daycare center, one administrator may handle all these functions. In universities or large school systems, responsibilities are divided among many administrators, each with a specific function.

Those who manage elementary and secondary schools are called *principals*. They set the academic tone and hire, evaluate, and help improve the skills of teachers and other staff. Principals confer with staff to advise, explain, or answer procedural questions. They visit classrooms, observe teaching methods, review instructional objectives, and examine learning materials. They actively work with teachers to develop and maintain high curriculum standards, develop mission statements, and set performance goals and objectives. Principals must use clear, objective guidelines for teacher appraisals, since pay is often based on performance ratings.

Principals also meet and interact with other administrators, students, parents, and representatives of community organizations. Decision-making authority has increasingly shifted from school district central offices to individual schools. Thus, parents, teachers, and other members of the community play an important role in setting school policies and goals. Principals must pay attention to the concerns of these groups when making administrative decisions.

Principals prepare budgets and reports on various subjects, including finances and attendance, and oversee the requisitioning and allocation of supplies. As school budgets become tighter, many principals are more involved in public relations and fund raising to secure financial support for their schools from local businesses and the community.

Principals must take an active role to ensure that students meet national academic standards. Many principals develop school/business partnerships and school-to-work transition programs for students. Increasingly, principals must be sensitive to the needs of the rising number of non-English speaking and culturally diverse students. Growing enrollments, which are leading to overcrowding at many existing schools, are also a cause for concern. When addressing problems of inadequate resources, administrators serve as advocates to build new schools or repair existing ones.

Schools continue to be involved with students' emotional welfare as well as their academic achievement. As a result, principals face responsibilities outside the academic realm. For example, in response to the growing number of dual-income and single-parent families and teenage parents, schools have established before- and after-school child-care programs or family resource centers, which also may offer parenting classes and social service referrals. With the help of community organizations, some principals have established programs to combat increases in crime, drug and alcohol abuse, and sexually transmitted disease among students.